Disaster Risk Reduction: From Integrated Research to Effective Risk Management

International Workshop on Governance of Climate-related Risks in Europe: the need for policy-oriented research
Brussels, 8-9 September 2011

Sálvano Briceño
Chair-elect, Science Committee, IRDR
Natural catastrophes worldwide 1980 – 2010
Number of events with trend

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Natural catastrophes worldwide 1980 – 2010
Overall and insured losses with trend
Significant natural catastrophes worldwide 1980 – 2010
10 costliest natural catastrophes ordered by overall losses

<table>
<thead>
<tr>
<th>Period</th>
<th>Event</th>
<th>Affected Area</th>
<th>Overall losses</th>
<th>Insured losses</th>
<th>Fatalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>25-30.8.2005</td>
<td>Hurricane Katrina</td>
<td>USA: LA, New Orleans, Slidell; MS, Biloxi, Pascagoula, Waveland, Gulfport</td>
<td>125,000</td>
<td>62,200</td>
<td>1,300</td>
</tr>
<tr>
<td>17.1.1995</td>
<td>Earthquake</td>
<td>Japan: Hyogo, Kobe, Osaka, Kyoto</td>
<td>100,000</td>
<td>3,000</td>
<td>6,400</td>
</tr>
<tr>
<td>12.5.2008</td>
<td>Earthquake</td>
<td>China: Sichuan, Mianyang, Beichuan, Wenchuan, Shifang, Chengdu, Guangyuan, Ngawa, Ya'an</td>
<td>85,000</td>
<td>300</td>
<td>84,000</td>
</tr>
<tr>
<td>17.1.1994</td>
<td>Earthquake</td>
<td>USA: Northridge, Los Angeles, San Fernando Valley, Ventura, Orange</td>
<td>44,000</td>
<td>15,300</td>
<td>60</td>
</tr>
<tr>
<td>6-14.9.2008</td>
<td>Hurricane Ike</td>
<td>USA, Cuba, Haiti, Dominican Republic, Turks and Caicos Islands, Bahamas</td>
<td>38,300</td>
<td>18,500</td>
<td>170</td>
</tr>
<tr>
<td>May-September 1998</td>
<td>Floods</td>
<td>China: Jangtsekiang, Songhua Jiang</td>
<td>30,700</td>
<td>1,000</td>
<td>4,200</td>
</tr>
<tr>
<td>27.2.2010</td>
<td>Earthquake, tsunami</td>
<td>Chile: Bio Bio, Concepción, Talcahuano, Coronel, Dichtato, Chillán, Del Maule, Talca, Curicó</td>
<td>30,000</td>
<td>8,000</td>
<td>520</td>
</tr>
<tr>
<td>23.10.2004</td>
<td>Earthquakes</td>
<td>Japan: Honshu, Niigata, Ojiya, Tokyo, Nagaoka, Yamakoshi</td>
<td>28,000</td>
<td>760</td>
<td>50</td>
</tr>
<tr>
<td>23-27.8.1992</td>
<td>Hurricane Andrew</td>
<td>USA: FL, Homestead; LA, Bahamas</td>
<td>26,500</td>
<td>17,000</td>
<td>60</td>
</tr>
</tbody>
</table>

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## Significant natural catastrophes worldwide 1980 – 2010
### 10 costliest natural catastrophes ordered by insured losses

<table>
<thead>
<tr>
<th>Period</th>
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<td>1,300</td>
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<td>6-14.9.2008</td>
<td>Hurricane Ike</td>
<td>USA. Cuba. Haiti. Dominican Republic. Turks and Caicos Islands. Bahamas</td>
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<td>17.1.1994</td>
<td>Earthquake</td>
<td>USA: Northridge, Los Angeles, San Fernando Valley, Ventura, Orange</td>
<td>44,000</td>
<td>15,300</td>
<td>60</td>
</tr>
<tr>
<td>7-21.9.2004</td>
<td>Hurricane Ivan</td>
<td>USA. Trinidad and Tobago. Venezuela. Colombia. Mexico</td>
<td>23,000</td>
<td>13,800</td>
<td>130</td>
</tr>
<tr>
<td>20-24.9.2005</td>
<td>Hurricane Rita</td>
<td>USA: LA, Lake Charles, Holly Beach, Cameron, New Orleans; MS; TX, Houston</td>
<td>16,000</td>
<td>12,100</td>
<td>10</td>
</tr>
<tr>
<td>27.2.2010</td>
<td>Earthquake, tsunami</td>
<td>Chile: Bio Bio, Concepción, Talcahuano, Coronel, Dichato, Chillán; Del Maule, Talca, Curicó</td>
<td>30,000</td>
<td>8,000</td>
<td>520</td>
</tr>
<tr>
<td>11-14.8.2004</td>
<td>Hurricane Charley</td>
<td>USA. Cuba. Jamaica. Cayman Islands</td>
<td>18,000</td>
<td>8,000</td>
<td>40</td>
</tr>
<tr>
<td>26-28.9.1991</td>
<td>Typhoon Mireille, floods</td>
<td>Japan: Kyushu, Hokkaido, Hakata</td>
<td>10,000</td>
<td>7,000</td>
<td>60</td>
</tr>
</tbody>
</table>

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## Significant natural catastrophes worldwide 1980 – 2010
### 10 deadliest events

<table>
<thead>
<tr>
<th>Period</th>
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<th>Overall losses</th>
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<th>Fatalities</th>
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</thead>
<tbody>
<tr>
<td>12.1.2010</td>
<td>Earthquake</td>
<td>Haiti: Port-au-Prince, Petionville</td>
<td>8,000</td>
<td>200</td>
<td>222,570</td>
</tr>
<tr>
<td>2-5.5.2008</td>
<td>Cyclon Nargis</td>
<td>Myanmar: Ayeyawaddy, Yangon, Bugalay, Irrawaddy, Bago, Karen, Mon, Laputta, Haing Kyi</td>
<td>4,000</td>
<td></td>
<td>140,000</td>
</tr>
<tr>
<td>29-30.4.1991</td>
<td>Tropical cyclon</td>
<td>Bangladesh: Bay of Bengal, Cox's Bazar, Chittagong, Bola, Noakhali districts, esp. Kutubdia</td>
<td>3,000</td>
<td>100</td>
<td>139,000</td>
</tr>
<tr>
<td>8.10.2005</td>
<td>Earthquake</td>
<td>Pakistan. India. Afghanistan</td>
<td>5,200</td>
<td>5</td>
<td>88,000</td>
</tr>
<tr>
<td>12.5.2008</td>
<td>Earthquake</td>
<td>China: Sichuan, Mianyang, Beichuan, Wenchuan, Shifang, Chengdu, Guangyuan, Ngawa, Ya'an</td>
<td>85,000</td>
<td>300</td>
<td>84,000</td>
</tr>
<tr>
<td>July-August 2003</td>
<td>Heatwave, drought</td>
<td>France. Germany. Italy. Portugal. Romania. Spain. United Kingdom</td>
<td>13,800</td>
<td>20</td>
<td>70,000</td>
</tr>
<tr>
<td>July-Sept. 2010</td>
<td>Heatwave, drought</td>
<td>Russia</td>
<td>2,000</td>
<td>20</td>
<td>56,000</td>
</tr>
<tr>
<td>21.6.1990</td>
<td>Earthquake</td>
<td>Iran: Caspian Sea, Gilan Provinz, Manjil, Rudbar, Zanjan, Safid, Qazvin</td>
<td>7,100</td>
<td>100</td>
<td>40,000</td>
</tr>
</tbody>
</table>
Global Trends - Disasters are NOT natural

Greater exposure to natural and human-induced hazards, climate change and variability

Socio-economic: poverty & unsustainable development styles, unplanned urban growth and migrations, lack of risk awareness & risk governance institutions & accountability...

Physical: insufficient land use planning, housing & critical infrastructure in hazard prone areas, little safety awareness...

Ecosystem & natural resource depletion (coastal, mountains, watersheds, wetlands, forests...)

HAZARDS + EXTREME EVENTS

VULNERABILITY
World Conference on Disaster Reduction
2nd WCDR, Kobe, Hyogo, Japan, 18-22 January 2005

Hyogo Framework for Action 2005-2015: Building the resilience of nations and communities to disasters (HFA)

✓ 3 Strategic goals
✓ 5 Priorities for action
✓ Implementation and follow-up

Expected outcome:

The WCDR resolved to pursue the following expected outcome for the next 10 years: **the substantial reduction of disaster losses, in lives & in the social, economic & environmental assets of communities & countries.** The realization of this outcome will require the full commitment & involvement of all actors concerned, including governments, regional & international organizations, civil society including volunteers, the private sector & the scientific community.
Hyogo Framework for Action 2005-2015 (continued)

3 strategic goals:

- The integration of disaster risk reduction into sustainable development policies & planning

- The development & strengthening of institutions, mechanisms & capacities to build resilience to hazards

- The systematic incorporation of risk reduction approaches into the implementation of emergency preparedness, response & recovery programmes
Hyogo Framework for Action 2005-2015 (continued)

Five priorities for action:

1. Governance: ensure that disaster risk reduction is a national and local priority with strong institutional basis for implementation

2. Risk identification: identify, assess and monitor disaster risks and enhance early warning

3. Knowledge: use knowledge, innovation and education to build a culture of safety and resilience at all levels

4. Reducing the underlying risk factors in various sectors (environment, health, construction, private sector etc.)

5. Strengthen disaster preparedness for effective response
Key questions:

• Why, despite advances in the natural and social science of hazards and disasters, do losses continue to increase?

• To what extent is the world-wide growth in disaster losses a symptom and indicator of unsustainable development?
Partners

• National and international science institutions
• National and international development assistance agencies and funding bodies
• National Committees

Co-Sponsors
The Science Plan

Addressing the challenge of natural and human-induced environmental hazards

An integrated approach to research on disaster risk through: an international, multidisciplinary (natural, health, engineering and social sciences, including socio-economic analysis) collaborative research programme.

IRDR Science Plan at:
http://www.irdrinternational.org/
Scope of IRDR

- Geophysical, climate and weather-related trigger events
- Effects of human activities on creating or enhancing disasters, including land-use practices
- Space weather and impact by near-Earth objects
- NOT disasters triggered by technological failure (but technological failure triggered by geophysical and climate-weather events), warfare...
Objective-1:

Characterization of hazards, vulnerability and risk
- 1.1: identifying hazards and vulnerabilities leading to risks;
- 1.2: forecasting hazards and assessing risks; and
- 1.3: dynamic modelling of risk
- HFA-2. Identify, assess and monitor disaster risks and enhance early warning
Objective 2:

Effective decision making in complex and changing risk contexts

– 2.1: Identifying relevant decision-making systems and their interactions
– 2.2: Understanding decision making in the context of environmental hazards; and
– 2.3: Improving the quality of decision-making practice

– HFA-1. DRR-national priority
– HFA-5. Strengthen disaster preparedness
Objective 3:

Reducing risk and curbing losses through knowledge-based actions

- 3.1: Vulnerability assessments;
- 3.2: Effective approaches to risk reduction
- Long-term database, monitoring systems and tools
- HFA-4. Reduce the underlying risk factors
- HFA-3. Knowledge - culture of safety and resilience
Cross-Cutting Themes

1. Capacity building
2. Case studies and demonstration projects
3. Assessment, data management and monitoring
   • HFA-2. Identify, assess and monitor disaster risks
   • HFA-1, -HFA-3,- HFA-4, HFA-5...

IPCC Special Report on Managing Risk of Extreme Climate Events
IRDR

WMO - World Weather Research Program
Storms, floods

UNESCO-IOC-Tsunami risk

ICSU
• Regional Programs
• IUGG-ENHANS
• CODATA

Socio-Economic Research Activities

ICSU-WMO-IOC/Unesco - World Climate Research Program
Climate extremes

ICSU-ISSC-UNU International Human Dimensions Program
Integrated Risk Governance
Land-Ocean Interactions in Coastal Zone

START
global change System for Analysis, Research and Training

FORIN
Risk Interpretation and Action (RIA)

• What do people (especially those at risk) think is likely to happen? & What will they do about it?
• Estimation of the likelihood and magnitude
• Evaluation of the vulnerability/resilience of the physical infrastructure

• Consideration of social and behavioral factors that place the local population at greater or lesser risk
IRDR Forensic Disaster Investigations (FORIN)

- Probe further into complex and underlying causes of growing disaster loss
- Fundamental cause of disasters
- Trace out and assign causal explanation of losses
- Intervening conditions that increased or reduce losses

- Series of case studies
- Common template and methodology
• Disaster Loss Data Project (DATA)
• ... need for more systematic and reliable information on such events. ... generate new information and data and to leave a legacy of coordinated and integrated global data and information sets across hazards and disciplines, with unprecedented degrees of access
• Assessment of Integrated Research on Disaster Risk (AIRDR)
• First systematic and critical assessment of research on disaster risk, provide baseline to measure effectiveness of multiple programmes
Sponsors: ICSU, ISSC, UN-ISDR

Consultative Forum

IPO

Scientific Committee

Dr. Jane E. Rovins, Executive Director
Lang Lang, Administrative Officer
Anna Rudashko, Communications Vacant, Science Officer

Located at CEODE, CAS, Beijing, China

UN ISDR Global Platform
Geneva, June 2011 (2013, 2015, ...)

Pacific Science Congress - Kuala Lumpur, June 2011

ICSU GA, Rome, September, 2011

IRDR Conference
Beijing, October/November 2011

Planet Under Pressure
London, March 2012

Science (ICSU)
IRDR Legacy

• An enhanced capacity around the world to address hazards and make informed decisions on actions to reduce their impacts.

• Societies to shift focus from response-recovery towards prevention-mitigation, building resilience and reducing risks, learning from experience and avoiding past mistakes.
Registration and Abstract Submission Open

IRDR Conference 2011
Oct. 31 - Nov. 2, Beijing
www.irdrinternational.org/conference2011

Why, despite advances in the natural and social science of hazards and disasters, do losses continue to increase?

To what extent is the world-wide growth in disaster losses a symptom and indicator of unsustainable development?

Disaster Risk: Integrating Science & Practice
Global Earthquake Model

Uniform and Open Standards to Calculate and Communicate Earthquake Risk
Seismic risk mitigation requires accurate, consensual and uniform risk estimates.

Since strong earthquakes know no political boundaries and occur relatively rarely, a global knowledge-sharing approach is required, which should lead also to the development of socio-economic impact assessment tools, including cost-benefit analysis, involving both the public and the private sectors, as well as international organisations, professionals associations and the wider community.
“A collaborative effort devised and launched by the OECD Global Science Forum, aimed at engaging the global community in the design, development and deployment of uniform open standards and tools for earthquake risk assessment worldwide”
9 countries have adhered so far

7 private organisations have partnered up with GEM so far

they contribute 13.6 M Euro

discussions and negotiations are ongoing with 15+ others

the OECD, WorldBank, UNESCO, UN/ISDR, IAEE and IASPEI are associative participants
PRIVATE PARTICIPANTS

Founders:

Munich RE  
3 Mill. €

ZURICH  
3 Mill. €

AIR WORLDWIDE  
1 Mill. €

Willis  
1 Mill. €

EUCENTRE  
1.6 Mill. €

Sponsors:

FM Global  
1 Mill. €

hannover re  
1 Mill. €
PUBLIC PARTICIPANTS

Australia  Belgium  Germany  Italy  New Zealand

Norway  Singapore  Switzerland  Turkey  United Kingdom
<table>
<thead>
<tr>
<th>Organization</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OECD</td>
<td>Organization for Economic Cooperation and Development</td>
</tr>
<tr>
<td>WORLD BANK</td>
<td>The World Bank</td>
</tr>
<tr>
<td>UN-ISDR</td>
<td>United Nations International Strategy for Disaster Risk Reduction</td>
</tr>
<tr>
<td>UNESCO</td>
<td>United Nations Educational, Scientific and Cultural Organization</td>
</tr>
<tr>
<td>IASPEI</td>
<td>International Association of Seismology and Physics of the Earth’s Interior</td>
</tr>
<tr>
<td>IAEE</td>
<td>International Association of Earthquake Engineering</td>
</tr>
</tbody>
</table>
GLOBAL COMPONENTS

For and from the community..

- **scientific modules** of GEM that are developed at a global scale to provide standards, methods and tools for global datasets
- addressed by **international consortia** that respond to Requests for Proposals (RfPs) released periodically by the Scientific Board
- before consortia are selected there is a thorough process of **expert elicitation, community feedback, and peer review**
- provide the **global framework** for the model which will be reviewed and further developed by the Regional Programmes to ensure they are adequate for regional needs and characteristics
Pilot project to generate GEM’s first products and develop GEM’s initial infrastructure
HAZARD GLOBAL COMPONENTS

- Expert elicitation, 5 Request for Proposals (RfP) drafting and publication
- International consortia submitted 9 proposals (20+ Institutions)
- 14 peer reviewers, Scientific Board selection, Governing Board decision.

Global Earthquake History
Global Instrumental Earthquake Catalogue
Global Active Fault and Seismic Source Database
Global Ground-Motion Prediction Equations
Global Geodetic Strain Rate Model
RISK GLOBAL COMPONENTS

- Expert elicitation, 5 Requests for Proposals (RfP) drafting, community feedback, RfP review and publication
- International consortia submitted 14 proposals (60+ Institutions)
- 20 peer reviewers, Scientific Board selection, Governing Board decision.

GEM Ontology and Taxonomy
Global Exposure Database
Global Earthquake Consequences Database
Global Vulnerability Estimation Methods
Inventory Data Capture Tools
Expert elicitation, 7 workshops and meetings, 1 Request for Proposal (RfP) drafting, community feedback, RfP review and publication

International consortia submitted 3 proposals (20+ institutions)

7 peer reviewers, Scientific Board selection, Governing Board decision.
Interaction between the OpenQuake calculation software, the OpenGEM risk assessment platform, the Regional Programmes and Global Components for the development of the GEM model.
GEM
Disaster Management and Risk organisations / initiatives

Research institutions
- earthquake/civil engineering
- seismology
- economics
- social sciences
- environmental/ sustainability
- (human) geography - urban planning
- IT
- development studies

Engineers and building institutions

Disaster Management and Risk organisations / initiatives

Private industry
- Insurance
- Banking
- Utilities, Energy
- Construction
- Leisure/tourism
- Consultancy
- IT and technology

National, Regional and Local (city) Governments

NGOs and civil society organizations

individuals in earthquake prone areas

Media
- online
- offline

Intergovernmental / other international organisations
CONCLUDING: MAIN FEATURES

...of a Global Earthquake Risk Model

- It must consist of a state-of-the-art, independent, transparent/open and consistent standard/model to calculate earthquake risk
- It must be dynamic, modular, flexible, expandable (i.e. not a map nor a report)
- It should serve the needs of all possible users, from the general public to the decision makers, communicating risk in an effective manner
- It must stem from a public-private partnership, combining the strengths (and objectives) of both the public and the private sectors
- It needs to be community-based and public-owned, in order to be consensual, accepted and actually used
- It has to feature regional and global coverage and facilitate technology-transfer
FURTHER INFORMATION

GEM Website
- Most update source of information
- News, results, calls, …

GEM Report 2009/2010
- 36 pages
- Available from website and hard-copy

Bi-monthly e-Newsletter
- Sign-up at website

GEM Handout
- Available from website and hard-copy
Thank you

www.irdrinternational.org